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ABSTRACT

This paper first notes the evolution of instructional development which has led to a need for the specification and development of computer aids to ISD activities, then notes several current efforts to meet this need, and finally describes the development of an Authoring Management System (AMS) designed to help manage the development phase of ISD. The AMS will track and coordinate the progress through all steps of the development, production, review, and revision of the instructional materials for entire courses on an objective by objective basis. It will aid in matching personal and production resources to production schedules, and will help assign available resources in the most efficient manner. It will establish and monitor deadlines for all intermediate products and function as a report generator yielding a variety of management reports from the cumulative data base it maintains. Finally it will function as a management simulation allowing manipulation for planning and prediction purposes. (WBC)

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SPECIFICATION AND DEVELOPMENT OF COMPUTER AIDS TO ISD

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by

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Description:

This paper will briefly trace the evolution in instructional development which has led to a need for the specification and development of computer-aids to ISD activities. Mention will be made of several current efforts to meet this need and a more detailed description of an Authoring Management System (AMS) designed to help manage the development phase of ISD will be presented.

Historically, instructional development has tended to be an artistic endeavor carried out in a cottage industry setting. All aspects of development responsibility, including analysis, design, development, revision, and, in many cases, production and evaluation, were concentrated in the individual instructional developer. The developer's approach to each instructional problem tended to be ad hoc and idiosyncractic. The developer, himself, more often than not had a background in media, in a particular content field, or at best some preparation from the school of education in curriculum development. Few had any formal preparation in instructional science.

This model of the Renaissance man as instructional artist solving each instructional problem as it arose with a combination of experience, intuition and insight began to be suspect as instructional development activities grew larger and more complex and as the consequences of inadequate training grew more and more expensive. Several important tools including task analysis, behavioral objectives specifications, powerful measurement and evaluation methods, began to emerge. To protect against the consequences of poor training, more reliance was placed on empirical or repeated trial-and-revision methods. While these methods might be expensive and time consuming, they, at least, allowed for the identification of inadequate instructional segments. However, at the point where actual development or revision of instructional materials took place, more often than not, the renaissance men still labored alone. His activities were still basically artistic in nature; his solutions to instructional problems were still idiosyncractic; the systematic procedures that he might apply tended

to be based on his own experiences and were not generalizable to other developers. There is currently a growing trend in military, industrial, and in a few academic circles away from this artistic approach to development toward the rigorous application of theory and research based models in an instructional engineering approach to development of instructional and training programs. This class of procedures may be variously identified as instructional systems development (ISD), a systematic approach to training (SAT), or other such designations. In general, they are characterized by well-defined analysis, design, implementation, and evaluation activities. With very few exceptions, however, they are much less rigorous and well defined in terms of the development or authoring activities. They often place heavy emphasis on the evaluation of existing materials and give little or no guidance to the authoring of new materials. When development of new materials is needed, the artistic empirical model reappears.

This apparent contradiction has been recognized and the specification, refinement and/or rigorous application of prescriptive procedures to the development phase of ISD is well advanced in several models including the interservice model developed at Florida State University (FSU) for Department of Defense (DOD) application. Similar models have been completely tested on several large-scale ISD projects, these include the aircrew training for the S-3A and SH-2F Anti-Submarine Warfare (ASW) Weapons systems. A larger demonstration is now underway with the development of the aircrew training for the P-3 aircraft. These applications of ISD are characterized by systematic specification of procedures at all phases of development, differentiation of staff and a high degree

of documentation including, but not limited to, many predefined intermediate products.

The approach to instructional development has, then, evolved from artistic, one-man efforts to rigorous, theme-oriented, systematic efforts, to produce instructional or training programs. However, the systematic development of instructional or training materials on any but the smallest of scales can impose a considerable administrative burden on staff. Tracking and coordinating the development of many objectives' instructional materials through the many analysis, design, authoring, production, review, evaluation, and revision steps can be a formidable task. Unless a more or less smooth flow of completed intermediate products can be maintained through all steps of the process, overloads may clog the system, materials may be lost, personnel will be utilized inefficiently and time will melt away with goals unmet. In addition, without some controls, authoring and reviewing may be of uneven quality or of inconsistent style. A system of computer aids would clearly be useful in all phases of ISD both from recording, reporting and evaluation standpoints, and from the standpoints of providing automated guides to actual production and quality control steps. Much attention has been paid to the implementation and evaluation problem through the development of computer managed instruction (CMI) systems. Now there is a growing concern with broadening the management support to include the analysis, design, development, and production activities also. Currently, several efforts are being funded towards this end by the Defense Advanced Research Projects Agency (DARPA) and the Naval Training Equipment Center (NAVTRAEQUIPCEN).

One of the efforts funded by DARPA is to develop a training course for DOD authors who will be developing instructional and training materials. This course teaches them a set of well defined prescriptive procedures to use during the development phase of ISD. This same project has an additional goal, the development of a computer-aided Author Management System (AMS) to help manage the development process and for making best use of the many personnel skills and roles required by the authoring team. This system is well along towards completion at this time.

Briefly, the AMS will track and coordinate the progress through all steps of the development (past task analysis), production, review, and revision of the instructional materials for entire courses, on an objective by objective basis. The system will aid in matching personnel and production resources to production schedules. It will help assign available resources in the most efficient manner and will establish and monitor deadlines for all intermediate products. The AMS will also function as a report generator yielding a variety of management reports from the cumulative data base it maintains on the courses. In addition, it will function as a management simulation allowing manipulation of schedules, resources, personnel, course structure, and/or media to generate projected changes in the other variables for planning and prediction purposes. The model will be "tuneable" and, to the extent reasonable, "self-tuning" to reflect changing real world conditions to yield better planning data. One of the most important functions of the AMS will be to provide protocols to aid authors, reviewers, evaluators, etc. It is hoped that these protocols will increase consistency and help with quality control across objectives and across personnel.

Real time evaluation of the individual responses to these protocols will guide personnel and will help identify personnel training needs and isolate revision requirements.

Two versions of the system will be developed. One will be a computer based system implemented on a 32K Wang 2200T with CRT, dual floppy disks, printer and mark sense card readers. The other, basically a simplified subset of the first, will be a "paper-based", manual system to be implemented through paper records with the support of a hand calculator. Essentially, the system may be considered to be a small number of data bases which are used in various combinations by programs which operationalize each management system function defined. Some of the data bases are briefly described below.

Author Management System (AMS) Data Bases

Course Structure:

--All course objectives.

- Hierarchical designator (subordinate-superordinate relationships implied)

--Classification of objective by content and behavior level.

--Media alternatives (ranked).

--Status vector (e.g., which ISD activities are finished, which still remain, etc.).

--Pointer to auxiliary data, if any (e.g., actual time required/event, etc.).

Development Event Definition:

--Each objective media/classification combination defined in terms of the specific authoring events required.

(Among other things this defines the positions in the status vector above.)

--Authoring roles required for each event.

--Time requirement of each role/event.

--Pointer to auxiliary data base, if any.

Personnel:

--Personnel to be applied to the effort.

--Skills of each person.

--Skill level of each skill for each person (e.g., high skill level, use whenever possible; moderate skill level, use in a pinch; etc.).

--Workload (i.e., task currently assigned to each person by hierarchy designator and event, total hours currently assigned).

--Deadlines for each task.

--"Protect" status of each person (e.g., to be used for overflow only; use whenever possible; etc.).

Calendar:

--Calendar profile of project period (i.e., workdays, holidays, weekends, etc., used in making all projections and in calculating all deadlines).

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These data bases can be used by the various programs (or manual procedures) of the management system in straightforward ways to generate reports, make projections and identify problem areas. They can be "copied" into temporary areas and manipulated for management simulation purposes or they may be updated with new information (in the "paper" version a temporary data base is only as far away as the

nearest copying machine). It is plain that the system will be able to track each objective (and therefore the course) through the development process reporting in detail on such things as:

--Current personnel load

--Current personnel deadlines

--Current personnel assignments

--Tasks/events completed

--Tasks/events in progress

--Tasks/events due on any day

--Tasks/events not started

--Projected start/finish dates for any/all tasks/events

Using the data bases, the system will also calculate projections such as:

--With current conditions, when will the course be finished?

--How much of each skill available is being used?

--How much of each skill is still available?

--How much of personnel x, y, and z can be protected while maintaining the projected completion data?

The data bases may be manipulated to simulate revised conditions and the system will answer the same questions specified above based on the revised conditions. Or, the system can be furnished a desired completion data and asked to calculate the conditions necessary to meet that deadline and to then determine such things as:

--How much of each skill available would be used, and how much would be available?

--How much of personnel x, y, and z could be protected while maintaining the desired completion date?

It is anticipated that a "data card" will track each objective through development. It will be "read" by the system after each event is finished. The system will then update the data base and recommend to management a person to complete the next event (based on who has the skills and who has the lightest load), and calculate a deadline (based on the time to complete the event and the last deadline in the person's workload). Management may accept or override this suggestion. Management may decide to check on the basic system's parameters. For example, how long does it really take to complete a certain event over the last twenty trials versus how long the system is estimating it will take. Management may either decide to retain the old estimate or update it for future calculations based on the new information. Or management may decide to check the impact of two weeks emergency leave for one of their review personnel. It may be that when the system calculates the new finish date, there is no difference, because the bottleneck for finishing was graphics, not review. Of course, this could have been found out by requesting the report outlining how much of each skill is being used. This system is obviously open-ended in its possibilities and not all of these options will be possible under the current project, due to limited resources and time. But this description outlines the possibilities of such systems.

The system design just described was originally envisioned as an aid to specifically managing the development phase of ISD. It has become obvious, however, that in a properly run ISD model the phases cannot be isolated but rather they interact strongly with each other. For example, during development, review and evaluation activities will be necessary which may require some

redesign, and media and production concerns will often interact with development. There is apparently a need for more general computer-aided management systems to help manage all phases of ISD from task analysis to final implementation and evaluation, thereby subsuming the functions described above as well as the more familiar CMI and evaluation functions which are now usually systematized. NAVTRAEQUIPCEN is currently funding efforts to specify, design, and possibly develop such a system. In this effort, a survey of many ISD activities and models is being undertaken in an attempt to identify information flow and data base requirements and to recommend those activities most amenable to automated systems support. It is possible to envision this effort or similar efforts as important steps towards a class of powerful, flexible, computer-aided authoring systems which manage and prompt while they also offer instruction on all aspects of ISD. Such management systems will allow a wider base of people to make more effective use of the sophisticated, prescriptive, ISD models which are now emerging.

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